INDE 572 – Stochastic Processes and Simulation
Syllabus, Spring 2022

Instructor: Saumya Sinha, Ph.D. (saumya.sinha@rice.edu)
Class Meetings: TR, 9:25-10:40am, Room SEW 133

Course Description: This course aims to enable students to build and analyze mathematical models of real-life applications where uncertainty is present. Applications are drawn from a variety of domains, such as inventory, reliability, telecommunications, and healthcare systems. The following topics will be covered: Discrete & continuous time Markov chains, Poisson processes, queueing systems, Markov decision processes, Monte Carlo & discrete-event simulation. Basic knowledge of probability (random variables, probability distribution functions, moments of random variables, expectations, conditional probability) will be assumed.

Prerequisites:
- INDE 571
- Familiarity with a scientific programming language, e.g., Matlab, Python, R
- Familiarity with multivariable calculus and elementary matrix manipulations (matrix addition and multiplication, Gaussian elimination)

Learning Outcomes: By the end of this course, students will be able to
- describe fundamental modeling tools for situations where uncertainty exists,
- develop discrete- and continuous-time Markov models of systems,
- understand basic principles of renewal theory and use them for performance calculations,
- model production and service systems using queueing models, and calculate long-run average performance measures,
- construct models for sequential decision making under uncertainty and determine optimal decisions for design and operations of various systems.

Textbooks:
There is no prescribed textbook for the class. Lecture notes will be available through Canvas, and the following books will be used as references.
- S.M. Ross, Introduction to Probability Models, Academic Press, 12th Edition, 2019.
- V.G. Kulkarni, Modeling and Analysis of Stochastic Systems, Chapman & Hall/CRC Texts in Statistical Science, 3rd Edition, 2016.
- E. Cinlar, Introduction to Stochastic Processes, Dover Books on Mathematics, 2013.
- F. Hillier and G. Lieberman, Introduction to Operations Research, McGraw Hill, 10th Edition, 2014.

Work and assessment:
Students will complete weekly homework assignments, a class project in 1-2 member teams, a midterm exam, and a final exam for this class. The grade will be distributed as follows:
- Homework -- 45% (weekly)
- Project -- 10%
- Midterm exam -- 20%
- Final exam -- 25%